

## CLAIMS

1. An electric press apparatus having a connecting mechanism comprising:
  - a base plate formed into a flat plate shape;
  - a plurality of guide bodies provided so that one end portions thereof intersect at right angles with the base plate;
  - a flat plate shaped support plate provided at the other end portions of the guide bodies so as to intersect at right angles with the guide bodies;
  - a slide plate provided so as to be slidably moved between the base plate and the support plate by being guided by the guide bodies;
  - a first motor for driving the slide plate slidably with respect to the guide bodies;
  - a ball screw shaft which is connected to the output shaft of the first motor and is pivotally supported so as to be moved in parallel with the guide bodies with respect to the support plate;
  - a nut member threadably engaged with the ball screw shaft; and
  - a differential mechanism, the upper end of which is fixed to the nut member and the lower end of which is fixed to the slide plate, for slightly changing the contact position between the ball screw shaft and balls incorporated in the nut member, the slide plate being moved vertically by the normal and reverse rotations of the ball screw shaft driven by the first motor, whereby a workpiece mounted on the base plate is subjected to fixed point working, characterized in that
    - the differential mechanism of the connecting mechanism comprises:
      - a frame body in which an opening of four inner wall surfaces corresponding to an opening portion hollowed out substantially into a rectangular parallelepipedic shape is provided in the upper surface, a stripe of slide groove is provided at a bottom surface portion in inner wall surface of one set of opposed surfaces of two sets of opposed surfaces, and the rectangular parallelepipedic opening portion forms a rigid body;
      - a movable body which has an upper plate portion having an inclined surface portion the top surface of which is horizontal and the back surface of which is inclined,

a stripe of slide groove formed on the back surface side of the upper plate portion, has a hole, which allows the ball screw shaft to pass through, in the central portion, is fitted in the opening of the frame body, and the nut member is fixed to the surface thereof;

a differential member which has a first guide engagement portion, which slidably engages with the slide groove formed in the frame body, in the lower end portion, has a second guide engagement portion, which slidably engages with the slide groove formed on the back surface side of the movable body, in the upper end portion, has a lower surface portion being horizontal and an upper surface portion being inclined, has a hole, which allows the ball screw shaft to pass through, in the central portion, and has a wedge shape fitted so as to be slidable in the frame body;

a screw shaft for moving the differential member in the horizontal direction; and

a second motor for moving the differential member in the horizontal direction via the screw shaft of the differential mechanism.

2. The electric press apparatus according to claim 1, characterized in that the slide groove formed on the back surface side of the upper plate portion of the movable body has a surface inclined along the inclined surface of the back surface of the upper plate portion.

3. The electric press apparatus according to claim 2, characterized in that the first guide engagement portion formed on the differential member has a surface inclined corresponding to the inclined surface of the back surface of the upper plate portion of the movable body.

4. The electric press apparatus according to any of claims 1 to 3, characterized in that a lid body for connecting opposed surfaces to each other is provided between two sets of opposed surfaces of the four inner wall surfaces of the frame body.

5. An electric press apparatus having a connecting mechanism comprising:

a base plate formed into a flat plate shape;

a plurality of guide bodies provided so that one end portions thereof intersect at right angles with the base plate;

a flat plate shaped support plate provided at the other end portions of the guide bodies so as to intersect at right angles with the guide bodies;

a slide plate provided so as to be slidably moved between the base plate and the support plate by being guided by the guide bodies;

a first motor for driving the slide plate slidably with respect to the guide bodies;

a ball screw shaft which is connected to the output shaft of the first motor and is pivotally supported so as to be moved in parallel with the guide bodies with respect to the support plate;

a nut member threadedly engaged with the ball screw shaft; and

a differential mechanism, the upper end of which is fixed to the nut member and the lower end of which is fixed to the slide plate, for slightly changing the contact position between the ball screw shaft and balls incorporated in the nut member,

the slide plate being moved vertically by the normal and reverse rotations of the ball screw shaft driven by the first motor, whereby a workpiece mounted on the base plate is subjected to fixed point working, characterized in that

the differential mechanism of the connecting mechanism comprises:

a frame body in which an opening of four inner wall surfaces corresponding to an opening portion hollowed out substantially into a rectangular parallelepipedic shape is provided in the upper surface, a stripe of slide groove is provided at a bottom surface portion in inner wall surface of one set of opposed surfaces of two sets of opposed surfaces, and the rectangular parallelepipedic opening portion forms a rigid body;

a movable body which has an upper plate portion having horizontal surfaces on the top surface and the back surface thereof, a stripe of slide groove formed on the back surface side of the upper plate portion, has a hole, which allows the ball screw shaft to pass through, in the central portion, is fitted in the opening of the frame body, and the nut member is fixed to the surface thereof;

a differential member which has a first guide engagement portion, which slidably engages with the slide groove formed in the frame body, in the lower end portion, has a second guide engagement portion, which slidably engages with the

slide groove formed on the back surface side of the movable body, in the upper end portion, has an upper surface portion being horizontal and a lower surface portion being inclined, has a hole, which allows the ball screw shaft to pass through, in the central portion, and has a wedge shape fitted so as to be slidable in the frame body;

a screw shaft for moving the differential member in the horizontal direction; and

a second motor for moving the differential member in the horizontal direction via the screw shaft of the differential mechanism.

6. The electric press apparatus according to claim 5, characterized in that the slide groove formed on the back surface side of the upper plate portion of the movable body has a horizontal surface along the back surface of the upper plate portion.

7. The electric press apparatus according to claim 6, characterized in that the surface of the slide groove of the frame body has an inclined surface along the inclined surface of the lower surface of the differential member, and the second guide engagement portion formed on the differential member has a surface inclined corresponding to the inclined surface of the lower surface of the differential member.

8. The electric press apparatus according to any of claims 5 to 7, characterized in that a lid body for connecting opposed surfaces to each other is provided between two sets of opposed surfaces of the four inner wall surfaces of the frame body.

9. A differential mechanism of connecting mechanism used in an electric press apparatus having a connecting mechanism comprising:

a base plate formed into a flat plate shape;

a plurality of guide bodies provided so that one end portions thereof intersect at right angles with the base plate;

a flat plate shaped support plate provided at the other end portions of the guide bodies so as to intersect at right angles with the guide bodies;

a slide plate provided so as to be slidably moved between the base plate and the support plate by being guided by the guide bodies;

a first motor for driving the slide plate slidably with respect to the guide bodies;

a ball screw shaft which is connected to the output shaft of the first motor and is pivotally supported so as to be moved in parallel with the guide bodies with respect to the support plate;

a nut member threadedly engaged with the ball screw shaft; and

a differential mechanism, the upper end of which is fixed to the nut member and the lower end of which is fixed to the slide plate, for slightly changing the contact position between the ball screw shaft and balls incorporated in the nut member,

the slide plate being moved vertically by the normal and reverse rotations of the ball screw shaft driven by the first motor, whereby a workpiece mounted on the base plate is subjected to fixed point working, characterized in that

the differential mechanism of the connecting mechanism comprises:

a frame body in which an opening of four inner wall surfaces corresponding to an opening portion hollowed out substantially into a rectangular parallelepipedic shape is provided in the upper surface, a stripe of slide groove is provided at a bottom surface portion in inner wall surface of one set of opposed surfaces of two sets of opposed surfaces, and the rectangular parallelepipedic opening portion forms a rigid body;

a movable body which has an upper plate portion having an inclined surface portion the top surface of which is horizontal and the back surface of which is inclined, a stripe of slide groove formed on the back surface side of the upper plate portion, has a hole, which allows the ball screw shaft to pass through, in the central portion, is fitted in the opening of the frame body, and the nut member is fixed to the surface thereof;

a differential member which has a first guide engagement portion, which slidably engages with the slide groove formed in the frame body, in the lower end portion, has a second guide engagement portion, which slidably engages with the slide groove formed on the back surface side of the movable body, in the upper end portion, has a lower surface portion being horizontal and an upper surface portion being inclined, has a hole, which allows the ball screw shaft to pass through, in the central portion, and has a wedge shape fitted so as to be slidable in the frame body;

a screw shaft for moving the differential member in the horizontal direction; and  
a second motor for moving the differential member in the horizontal direction via the screw shaft of the differential mechanism.

10. The differential mechanism according to claim 9, characterized in that the slide groove formed on the back surface side of the upper plate portion of the movable body has a surface inclined along the inclined surface of the back surface of the upper plate portion.

11. The differential mechanism according to claim 10, characterized in that the first guide engagement portion formed on the differential member has a surface inclined corresponding to the inclined surface of the back surface of the upper plate portion of the movable body.

12. The differential mechanism according to any of claims 9 to 11, characterized in that a lid body for connecting opposed surfaces to each other is provided between two sets of opposed surfaces of the four inner wall surfaces of the frame body.

13. A differential mechanism of connecting mechanism used in an electric press apparatus having a connecting mechanism comprising:

- a base plate formed into a flat plate shape;

- a plurality of guide bodies provided so that one end portions thereof intersect at right angles with the base plate;

- a flat plate shaped support plate provided at the other end portions of the guide bodies so as to intersect at right angles with the guide bodies;

- a slide plate provided so as to be slidably moved between the base plate and the support plate by being guided by the guide bodies;

- a first motor for driving the slide plate slidably with respect to the guide bodies;

- a ball screw shaft which is connected to the output shaft of the first motor and is pivotally supported so as to be moved in parallel with the guide bodies with respect to the support plate;

- a nut member threadedly engaged with the ball screw shaft; and

a differential mechanism, the upper end of which is fixed to the nut member and the lower end of which is fixed to the slide plate, for slightly changing the contact position between the ball screw shaft and balls incorporated in the nut member,

the slide plate being moved vertically by the normal and reverse rotations of the ball screw shaft driven by the first motor, whereby a workpiece mounted on the base plate is subjected to fixed point working, characterized in that

the differential mechanism of the connecting mechanism comprises:

a frame body in which an opening of four inner wall surfaces corresponding to an opening portion hollowed out substantially into a rectangular parallelepipedic shape is provided in the upper surface, a stripe of slide groove is provided at a bottom surface portion in inner wall surface of one set of opposed surfaces of two sets of opposed surfaces, and the rectangular parallelepipedic opening portion forms a rigid body;

a movable body which has an upper plate portion having horizontal surfaces on the top surface and the back surface thereof, a stripe of slide groove formed on the back surface side of the upper plate portion, has a hole, which allows the ball screw shaft to pass through, in the central portion, is fitted in the opening of the frame body, and the nut member is fixed to the surface thereof;

a differential member which has a first guide engagement portion, which slidably engages with the slide groove formed in the frame body, in the lower end portion, has a second guide engagement portion, which slidably engages with the slide groove formed on the back surface side of the movable body, in the upper end portion, has an upper surface portion being horizontal and a lower surface portion being inclined, has a hole, which allows the ball screw shaft to pass through, in the central portion, and has a wedge shape fitted so as to be slidable in the frame body;

a screw shaft for moving the differential member in the horizontal direction; and

a second motor for moving the differential member in the horizontal direction via the screw shaft of the differential mechanism.

14. The differential mechanism according to claim 13, characterized in that the slide groove formed on the back surface side of the upper plate portion of the movable body has a horizontal surface along the back surface of the upper plate portion.

15. The differential mechanism according to claim 14, characterized in that the surface of the slide groove of the frame body has an inclined surface along the inclined surface of the lower surface of the differential member, and the second guide engagement portion formed on the differential member has a surface inclined corresponding to the inclined surface of the lower surface of the differential member.

16. The differential mechanism according to any of claims 13 to 15, characterized in that a lid body for connecting opposed surfaces to each other is provided between two sets of opposed surfaces of the four inner wall surfaces of the frame body.